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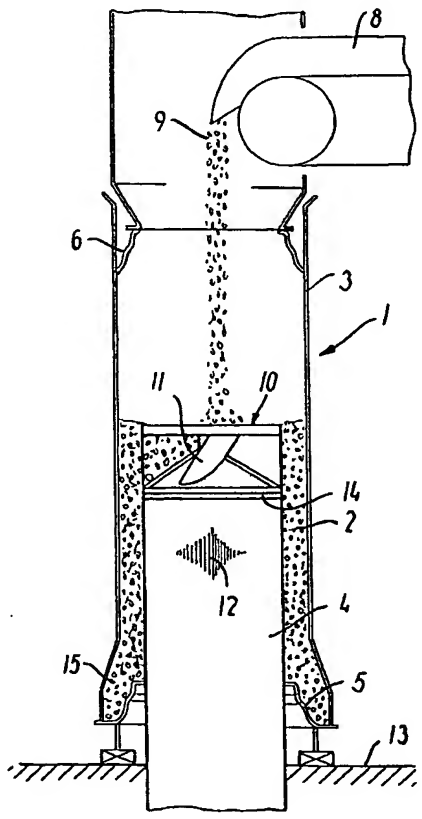
(54) Title: A METHOD AND AN APPARATUS FOR THE MANUFACTURE OF CONCRETE PIPES



(57) Abstract: A method and an apparatus for the manufacture of concrete pipes (2) com-prising an outer layer, said outer layer forming the pipe (2) itself, as well as an inner layer of greater density in surface structure, said inner layer being applied by an applicator in a mould (1) comprising both outer (3) and inner (4) mould parts, said applicator being formed by an inner mould part or core (4) or by an applicator unit in immediate connection with the core (4), said applicator applying the inner layer during simultaneous or during immedi-ately following vibration, said inner layer being applied during movement of the inner mould part or core (4) in its longitudinal direction, in which core one or more supply openings (14) are provided along the circumference of the core (4) at the upper end of the core (4) for the supply of a further mate-rial.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A method and an apparatus for the manufacture of concrete pipes

The invention relates to a method for the manufacture of concrete pipes as described in the introductory portion of claim 1.

The invention also relates to an apparatus for the manufacture of concrete pipes as described in the introductory portion of claim 9.

Concrete pipes, which are normally used for the discharge of wastewater via sewers as well as for the discharge of rainwater, are generally manufactured such that the pipe exclusively consists of the base concrete which is used for the casting of the pipe.

Since the development within the field of environment and wastewater has involved separation of wastewater and rainwater so that the rainwater bypasses the cleaning systems in separate conduits to reduce the load on the wastewater cleaning systems, a concentration of the wastewater occurs at the same time, which means that the wastewater is even more corrosive for the concrete pipes than before.

To prevent the corrosive wastewater from attacking the concrete pipes, it has e.g. been attempted to line the pipes with another material than concrete for the manufacture of what is called lined pipes. Such a lining may be carried out in several different ways, but generally it is done in that the lining is placed on the core in the mould, following which the concrete pipe is cast and removed from the mould in a conventional manner, which means that the cast pipe and the outer form are lifted off the core, and the outer form is lifted off the pipe.

In addition to increased manufacturing costs and problems of density when joining the pipes to a conduit, this also involves a reduction of the capacity in the manufacture of such pipes.

US 5,051,223 discloses another method of manufacturing corrosion resistant concrete pipes. Here, use is made of a radial pressing head which is basically composed of a plurality of oppositely running rolls which form the internal part of a concrete pipe. The external part is formed in an ordinary manner by means of an outer form.

Concrete is poured into the mould, while the radial pressing head is run up through the vertically positioned outer form. When the radial pressing head with its oppositely running rolls runs up through the outer form, these oppositely running rolls form the inner surface of the pipe. A smoothing device is provided at a fixed distance after the oppositely running rolls, seen in the direction of travel of the radial pressing head, in which smoothing device an impregnation liquid is supplied to the internal surface of the concrete pipe. This impregnation liquid is supplied while the concrete is still wet, whereby the impregnation liquid in the following smoothing permeates about 10 mm into the inner surface of the pipe wall. This subsequent smoothing, also called polishing, takes place after the pipe has been formed.

Today, however, a large number of concrete pipes is manufactured according to a different method, viz. by the so-called vibration method. For this manufacturing method, it is not possible to use the above-mentioned known technique for the manufacture of e.g. corrosion resistant concrete pipes.

In the manufacture of concrete pipes according to the vibration casting method, the technique may again be divided into two methods, viz. the method with a rising core and the method with a fixed core.

In the rising core method, as shown e.g. in European Patent No. 0 674 573 B, the casting machine comprises a casting mould which basically consists of an outer formwork in the form of an outer form, an inner formwork in the

form of a core, a bottom formwork in the form of a bottom ring and a feed system. In addition, there is profile ring for the forming of the spigot end of the pipe, defining the upward boundary of the casting mould.

In the making of the pipe, vibration is applied via vibration means which may be arranged in the core, on the outer form or as table vibration, where core or outer form stands on a vibrating table.

In the manufacture of a pipe according to the rising core method, the casting process basically takes place in that the core is moved up through the bottom ring, following which it is stopped, the core being present at a certain height in the mould. Then, concrete is poured into the mould from its upper part. Subsequently, the core is moved continuously up through the mould while concrete is being filled into the mould. The concrete is distributed and compacted during the process by a rotor arranged on the top of the core, while the concrete is vibrated under the action of a strong vibrator, normally arranged centrally in the core. A profile ring is arranged at the upper end of the outer form, and when the mould is filled with concrete, this profile ring defines the upper boundary of the mould, together with the outer form and the core. When the mould has been filled with concrete, pressing is performed, and then the profile ring is rotated slightly to and fro in order to smooth the spigot end. One of the effects of this casting process is that it is ensured that the manufactured pipes have the same length.

In the manufacture of pipes according to the fixed core method, the casting process basically takes place in that the core is fixedly positioned, and that an outer form having a bottom ring clamped thereto is arranged over the core. The concrete is then poured down into the mould from above, while vibration is applied to the mould. When the mould has been filled, a profile ring is moved down at the top of the mould, and thereby the spigot end of the pipe is formed. Then the core is removed from the mould by means of a crane or similar lifting tool which positions pipe, bottom ring and outer form

for setting at a suitable location, where the outer form is loosened from the bottom ring and the crane lifts the outer form off and away.

Accordingly, the object of the invention is to provide a method of manufacturing concrete pipes with an inner surface, where the properties are improved with respect to surface quality, e.g. in that the inner surface inter alia exhibits a greater corrosion resistance, better flow properties and more attractive surface structure.

A further object of the invention is to provide an apparatus for the manufacture of such pipes.

The method of the invention, as described in claim 1, ensures that when the pipe itself has been formed, a further layer of greater density in structure is applied to the inner side of the pipe through the inner mould part, the so-called core, via nozzles or gaps, while the mould and thereby the concrete are vibrated. Vibration of the mould keeps in it in a form of fluid phase. When the concrete is maintained in such a fluid phase during the feeding of material of greater density in structure, the effect is achieved that the two materials merge to a mutually denser structure, thereby providing a tighter bond between the two materials.

Claim 2 describes an advantageous way of feeding the material of greater density in structure, viz. by feeding the further material through the inner mould part, the core, while it is displaced into the outer mould part, feed openings being provided in the core along its circumference at the upper end of the core for the supply of the further material.

Claim 3 describes a method, where the applicator in the apparatus is formed by a core which is rotated after the forming of the pipe, a further layer being applied internally to the pipe from one or more rows of nozzles. In this case, the apparatus for the performance of the method is preferably

of the fixed core type.

Claim 4 describes a method, where the applicator for the application of the inner layer is formed by the rotor, which is also used for forming the pipe beforehand. At its lower part, the rotor is provided with one or more supply openings for the further material.

Claim 5 describes a method, where the inner layer is applied to a top and/or bottom ring before these are applied to the other mould parts. This ensures that the parts of the finished concrete pipe which will constitute the parts to be joined in the laying of a pipeline, also have a surface of greater density than the outer surface of the concrete pipe.

Claim 6 describes a similar method, but where the further layer is applied to the bottom and/or top ring after the bottom and/or top ring has been connected with the other mould parts, and before the mould is filled with concrete.

Claim 7 describes an embodiment of the method, where the spigot end of the pipe is provided with the further material to form the inner layer of greater density in structure.

Claim 8 states that the further material may be fed in the form of paste, powder or liquid.

Claim 9 defines an apparatus for the performance of the method, where the core, according to the rising core principle, constitutes the applicator. The further material is fed through one or more annular grooves, said grooves extending along the circumference of the core and being arranged at the front end of the core seen in the direction of travel of the core.

Claim 10 likewise defines an apparatus with an applicator for a core ac-

cording to the rising core principle, where the annular groove or grooves are formed with a plurality of nozzles or gaps for the supply of the further material.

Claim 11 defines an apparatus with an applicator according to the fixed core principle, where the core is rotated after or during the forming of the pipe. The core is provided with one or more grooves which extend in the longitudinal direction of the core, said groove or grooves extending in the entire effective length of the core. The further material is fed though the groove or grooves adapted for the purpose, while the core is rotated about its longitudinal axis. The core is rotated at least so much that the entire inner surface of the pipe is covered by the further material.

Claim 12 defines an apparatus as described in claim 11, but where the groove or grooves extend as straight grooves in the longitudinal direction of the core.

Claim 13 defines an apparatus as described in claim 11, but where the groove or grooves extend in a form of a spiral along the surface of the core in the longitudinal direction.

Claims 14 and 15 define an apparatus where the applicator is placed on a rotor in the lower part thereof, so that the further material is fed to the inner surface of the pipe by means of a plurality of nozzles or gaps, just after the pipe itself has been formed.

The further material is preferably fed under pressure and while mould and/or pipe are vibrated. The pressure may be provided by the supply of the further material, or may optionally be applied by an expedient configuration of the core in connection with the provided gap or gaps in the surface of the core.

The invention will be described more fully below with reference to the drawing, where

fig. 1 shows an apparatus for the casting of concrete pipes with an inner layer of greater density in structure, where the applicator is formed by a longitudinal gap in the core,

fig. 2 shows an apparatus for the casting of concrete pipes with an inner layer of greater density in structure, where the applicator in the core is formed by a longitudinal gap with a plurality of nozzles,

fig. 3 shows an apparatus for the casting of concrete pipes with an inner layer of greater density in structure, where the applicator is formed by a gap twisted along the surface of the core with a plurality of nozzles in the gap,

fig. 4 shows an apparatus for the casting of concrete pipes with an inner layer of greater density in structure, where the applicator is formed by the lower part of the rotor,

fig. 5 shows an apparatus for the casting of concrete pipes with an inner layer of greater density in structure, where the applicator in the core is formed by a gap which extends along the circumference, and which is present in the upper end of the core, and

fig. 6 shows an apparatus for the casting of concrete pipes with an inner layer of greater density in structure, where the applicator in the core is formed by a gap which extends along the circumference, and which has a plurality of nozzles therein and is present at the upper end of the core.

Now, preferred embodiments of the invention will be described, where use is made of a casting mould 1 for the casting of a concrete pipe 2, said casting mould 1 comprising an outer formwork in the form of an outer form 3, an inner formwork in the form of a core 4, a bottom formwork in the form of a bottom ring 5, a top formwork in the form of a profile ring or top ring 6 for forming the spigot end 7 of the pipe 2, and a feed system 8 for the supply of concrete 9. Vibration is applied in connection with the casting mould. This is done in a preferred embodiment by means of a vibrator 12 preferably arranged in the core 4. The vibration may be applied from an external source of vibration and optionally from a vibration table.

When a pipe 2 is to be cast by means of the rising core principle, this roughly takes place in that concrete 9 is poured via the feed system 8 into the mould 1, where the outer form 3 rests on the bottom ring 5 which stands on a substrate 13. The rotor 10 is rotated about a longitudinal axis which extends through the centre of the core 4. When rotating, the rotor 10 presses the concrete against the inner side of the outer form 3, whereby the pipe 2 is formed, while the core 4 moves – rises – into the outer form 3. The vibration from the vibrator 12 contributes to making the concrete 9 more uniform and dense. The length of the pipe 2 is determined by the position of the profile ring 6 in the outer form 3, and when the rotor 10 passes through the profile ring 6, it simultaneously casts the spigot end 7 of the pipe 2, which ensures that the pipes 2 have a uniform length. The surface of the spigot end 7 is finished in that the profile ring/top ring 6 is rotated and pressed on to the spigot end 7 of the pipe 2, said spigot end 7 being smoothed hereby.

A pipe may also be cast according to a fixed core principle. This principles differs from the rising core principle in that the core has been placed in the mould in advance and is not movable in its longitudinal direction. When the concrete is poured into the mould by generally used distribution means,

said mould consisting of core, outer form, bottom ring and top ring, vibration is applied from a vibrator, which is preferably arranged in the core, but may also be applied from an external vibrator or optionally from a vibration table.

According to the invention, a plurality of nozzles and/or gaps 14 are provided on the core 4, in case of the rising core as well as the fixed core, to supply a further material, so that the further material is supplied to the internal or inner surface of the concrete pipe 2 just formed.

To ensure that the spigot end 7 and the socket 15 of the pipe 2 are also provided with a further material, the further material may be supplied to both the profile ring 6 and the bottom ring 5 before they are applied to the outer form 3. This may be done by supplying the further material by supply means from the core 4, from the outer form 3 or optionally by precoating the profile ring 6 and/or the bottom ring 5. The supply of the further material to the spigot end 7 may also take place in that the profile ring 6 is lifted and then the further material is filled by supply means over the spigot end 7 of the pipe 2, following which the profile ring 6 is lowered or pressed down over the spigot end 7 during simultaneous or during immediately following vibration.

In a preferred embodiment of the arrangement of nozzles and/or gaps 14 on the core, as shown in figures 1 and 2, nozzles and/or gaps 14 are arranged in the longitudinal direction of the core 4, and the further material is fed to the pipe 2 by rotation of the core 4 about its longitudinal axis.

In another preferred embodiment of the arrangement of nozzles and/or gaps 14 on the core 4, as shown in figure 3, nozzles and/or gaps 14 are arranged in a groove which is twisted like a form of a spiral or threads in the longitudinal direction of the core 4. Here, too, the further material is fed to the inner surface of the pipe by rotation of the core 4 about its longitudinal axis. In this case, the rotation may optionally be supplemented by a move-

ment in the longitudinal direction.

The embodiments of the arrangement of nozzles and/or gaps on the core 4 according to figures 1, 2, and 3 may advantageously also be used in the supply of the further material with the fixed core casting principle. In this case, the core will then be positioned in the casting mould, and after the mould has been filled with concrete 9, the core 4 will be rotated about its own longitudinal axis either during vibration or during immediately following vibration, while the further material is supplied through the nozzles and/or gaps arranged in the core 4.

The core is rotated such that the row or rows of nozzles supplying the further material to the pipe are moved precisely so far that the supplied material covers the entire inner side of the pipe.

In a third preferred embodiment of the arrangement of nozzles and/or gaps 14, as shown in figure 4, these are placed on the rotor 10 on the lower end thereof, so that the supply of the further material takes place during the rotation of the rotor 10. The rotor 10 is provided with suitable means (not shown) for providing a plurality of nozzles and/or gaps with the further material which is to be applied to the inner surface of the pipe 2. The supply may take place through channels formed in the blades 11 of the rotor 10, or through supply channels extending from an area near the centre of the rotor 10 to an area near the circumference of the rotor 10.

In a fourth preferred embodiment of the arrangement of nozzles and/or gaps 14, as shown in figures 5 and 6, these nozzles and/or gaps are arranged in an annular groove 14 which extends along the circumference of the core 4. The annular groove 14 is preferably arranged at the front end of the core 4 in the direction of travel of the core 4. In case that it is not possible to move sufficient material through this one annular groove 14, several annular grooves may be arranged in the immediate vicinity of the first an-

nular groove 14.

Supply of the further material during or during immediately following vibration provides the effect that the further material is joined with the concrete in such a manner that a form of diffusion of the two materials into each other occurs, so that a type of sliding transition from the concrete and out into the further material takes place.

This ensures a strong bond between the joined materials.

When a pipe has been cast, it is removed from the mould in the usual manner, which means that with the rising core principle the core is moved down to the starting position, the profile ring at the top of the pipe and the outer form are removed so that the pipe stands on the bottom ring ready for transport to a setting area or the like. Here, it may be decided to allow the profile ring to remain on the top of the pipe during the finish-setting to achieve even better tolerances on the spigot end of the pipe. This, however, will require use of more profile rings.

When removing the pipe from the mould with the fixed core principle, pipe, bottom ring and outer form are lifted off the core by means of a crane and are placed on setting location adapted for the purpose. At the setting location, the outer form is loosened from the bottom ring, and the outer form is lifted off the pipe by a crane or the like.

In an optional further embodiment, it is conceivable that the further material is supplied only to a portion of the circumference of the pipe, so that the further material just covers the inner part of the pipe, which will face downwards when the pipe is positioned substantially horizontally with the inclination required for the flow of water, wastewater or the like. In the rising core embodiment, this may optionally be done by blocking the part of the gap or the nozzles which is not to receive any further layer. In the fixed core em-

bodiment, it is sufficient to rotate the core just one half of a rotation or as far as is found necessary. In the embodiment where the applicator is formed by the rotor, the supply to the nozzles may be blocked in a controlled manner, so that the further material is just fed through the nozzles when the nozzles are at the area to which the further material is to be supplied.

PATENT CLAIMS

1. A method for the manufacture of concrete pipes comprising an outer layer, said outer layer forming the pipe itself, as well as an inner layer of greater density in surface structure, said inner layer being supplied by an applicator in a mould comprising inner as well as outer mould parts, c h a r a c t e r i z e d in that the applicator is formed by an inner mould part or core (4) or by an applicator unit in direct connection with the core, said applicator supplying the inner layer during simultaneous or during immediately following vibration.

2. A method according to claim 1, c h a r a c t e r i z e d in that the inner layer is applied during movement of the inner mould part or core (4) in its longitudinal direction, said core (4) being formed with one or more supply openings (14) along the circumference of the core (4) at the upper end of the core (4) for the supply of a further material.

3. A method according to claim 1, c h a r a c t e r i z e d in that the inner layer is applied when the outer pipe (2) is formed in that the core (4) is rotated and a further material is applied through one or more supply openings (14), which essentially extend in the longitudinal direction of the core (4).

4. A method according to claim 1, c h a r a c t e r i z e d in that the inner layer is applied by an applicator in the form of a rotor (10) for the forming of a concrete pipe (2), in which rotor one or more supply openings (14) are provided in the part of the rotor (10) which faces away from the direction of travel of the rotor (10).

5. A method according to claims 1-4, c h a r a c t e r i z e d in that the inner layer is applied to a bottom ring (5) and/or a top ring (6) before said ring or rings are applied to the other mould parts.

6. A method according to claims 1-4, c h a r a c t e r i z e d in that the inner layer is applied to a bottom ring (5) and/or a top ring (6) when said ring or rings have been connected with the other mould parts and before the mould is filled with concrete (9).

7. A method according to claims 1-4, c h a r a c t e r i z e d in that the spigot end (7) of the pipe is provided with the inner layer in that a top ring or a profile ring (6) is lifted, the further material is filled over the spigot end (7) of the pipe (2), and then the profile ring (6) is lowered/pressed down over the spigot end (7) during simultaneous or during immediately following vibration.

8. A method according to claims 1-7, c h a r a c t e r i z e d in that the further material may be in the form of a paste, powder or liquid.

9. An apparatus for the manufacture of concrete pipes by the method according to claim 1 or 2, c h a r a c t e r i z e d in that the applicator is formed by a core (4) which is intended to be moved in its longitudinal direction into the outer form (3), an upper end of said core (4) being provided with one or more annular grooves (14) for the supply of a further material.

10. An apparatus for the manufacture of concrete pipes by the method according to claim 1 or 2, c h a r a c t e r i z e d in that the applicator is formed by a core (4) which is intended to be moved in its longitudinal direction into the outer form (3), an upper end of said core (4) being provided with a plurality of nozzles or gaps arranged at a short distance from each other in one or more grooves (14) along the circumference of the core (4).

11. An apparatus for the manufacture of concrete pipes by the method according to claim 1 or 3, c h a r a c t e r i z e d in that the applicator is formed by a core (4) which is intended to be rotated during forming or is rotated at completed forming, and that the core (4) is provided with one or more

grooves (14), said grooves (14) being arranged such that they extend in the longitudinal direction of the core (4) in one or more rows.

12. An apparatus according to claim 11 for the manufacture of concrete pipes by the method according to claim 1 or 3, c h a r a c t e r i z e d in that the groove or grooves (14) extend in a straight line in the longitudinal direction of the core (4).

13. An apparatus according to claim 11 for the manufacture of concrete pipes by the method according to claim 1 or 3, c h a r a c t e r i z e d in that the groove or grooves (14) extend in a form of a spiral along the surface of the core (4) from one end of the core toward or to the other end of the core (4).

14. An apparatus for the manufacture of concrete pipes by the method according to claim 1 or 4, c h a r a c t e r i z e d in that the rotor (10) is arranged on the front of the core (4) relative to the direction of travel of the core (4), and that the rotor (10) is provided with supply means (14) for the further material to be supplied to the inner surface of the pipe (2).

15. An apparatus according to claim 14 for the manufacture of concrete pipes by the method according to claim 1 or 4, c h a r a c t e r i z e d in that the supply means (14) provided on the rotor (10) are configured as nozzles and/or gaps.

[Received by the International Bureau on 04 August 2004 (04.08.2004) ; original claims 9, 10, 14 and 15, amended ; remaining claims ; unchanged]

6. A method according to claims 1-4, c h a r a c t e r i z e d in that the inner layer is applied to a bottom ring (5) and/or a top ring (6) when said ring or rings have been connected with the other mould parts and before the mould is filled with concrete (9).

7. A method according to claims 1-4, c h a r a c t e r i z e d in that the spigot end (7) of the pipe is provided with the inner layer in that a top ring or a profile ring (6) is lifted, the further material is filled over the spigot end (7) of the pipe (2), and then the profile ring (6) is lowered/pressed down over the spigot end (7) during simultaneous or during immediately following vibration.

8. A method according to claims 1-7, c h a r a c t e r i z e d in that the further material may be in the form of a paste, powder or liquid.

9. An apparatus for the manufacture of concrete pipes by the method according to claim 1 or 2, c h a r a c t e r i z e d in that the applicator is formed by a core (4) which is intended to be moved in its longitudinal direction into the outer form (3), an upper end of said core (4) being provided with one or more annular grooves (14) for the supply of a further material with a greater density to form an inner layer of greater density in the pipe structure.

10. An apparatus for the manufacture of concrete pipes by the method according to claim 1 or 2, c h a r a c t e r i z e d in that the applicator is formed by a core (4) which is intended to be moved in its longitudinal direction into the outer form (3), an upper end of said core (4) being provided with a plurality of nozzles or gaps arranged at a short distance from each other in one or more grooves (14) along the circumference of the core (4) for the supply of a further material with a greater density to form the inner layer of greater density in the pipe structure.

11. An apparatus for the manufacture of concrete pipes by the method ac-

cording to claim 1 or 3, c h a r a c t e r i z e d in that the applicator is formed by a core (4) which is intended to be rotated during forming or is rotated at completed forming, and that the core (4) is provided with one or more grooves (14), said grooves (14) being arranged such that they extend in the longitudinal direction of the core (4) in one or more rows.

12. An apparatus according to claim 11 for the manufacture of concrete pipes by the method according to claim 1 or 3, c h a r a c t e r i z e d in that the groove or grooves (14) extend in a straight line in the longitudinal direction of the core (4).

13. An apparatus according to claim 11 for the manufacture of concrete pipes by the method according to claim 1 or 3, c h a r a c t e r i z e d in that the groove or grooves (14) extend in a form of a spiral along the surface of the core (4) from one end of the core toward or to the other end of the core (4).

14. An apparatus for the manufacture of concrete pipes by the method according to claim 1 or 4, c h a r a c t e r i z e d in that the rotor (10) is arranged on the front of the core (4) relative to the direction of travel of the core (4), and that the rotor (10) is provided with supply means (14) for the further material with a greater density to be supplied to the inner surface of the pipe (2) to form the inner layer of greater density in the pipe structure, which supply means (14) are placed on the outer and/or lower part of the rotor (10).

15. An apparatus according to claim 14 for the manufacture of concrete pipes by the method according to claim 1 or 4, c h a r a c t e r i z e d in that the supply means (14) provided on the outer and/or lower part of the rotor (10) are configured as nozzles and/or gaps.

Statement under Article 19(1):

In order to overcome the citations and thus achieve that the claims in the above application show novelty, we have made the following amendments.

The amendments consist in a new, amended claim 9 together with amended claims 10, 14 and 15. The remaining claims are unamended.

The amendments do not go beyond the disclosure in the international application as filed.

The amendments will affect the citation of claim 9, 10, 14 and 15 on p. 5 and p. 6 of the description.

The entire former sheets no. 14 and 15 could be replaced by these sheets no. 14 and 15.

We hope that the amendments made are considered to render the invention according to the present application novel in relation to the cited documents.

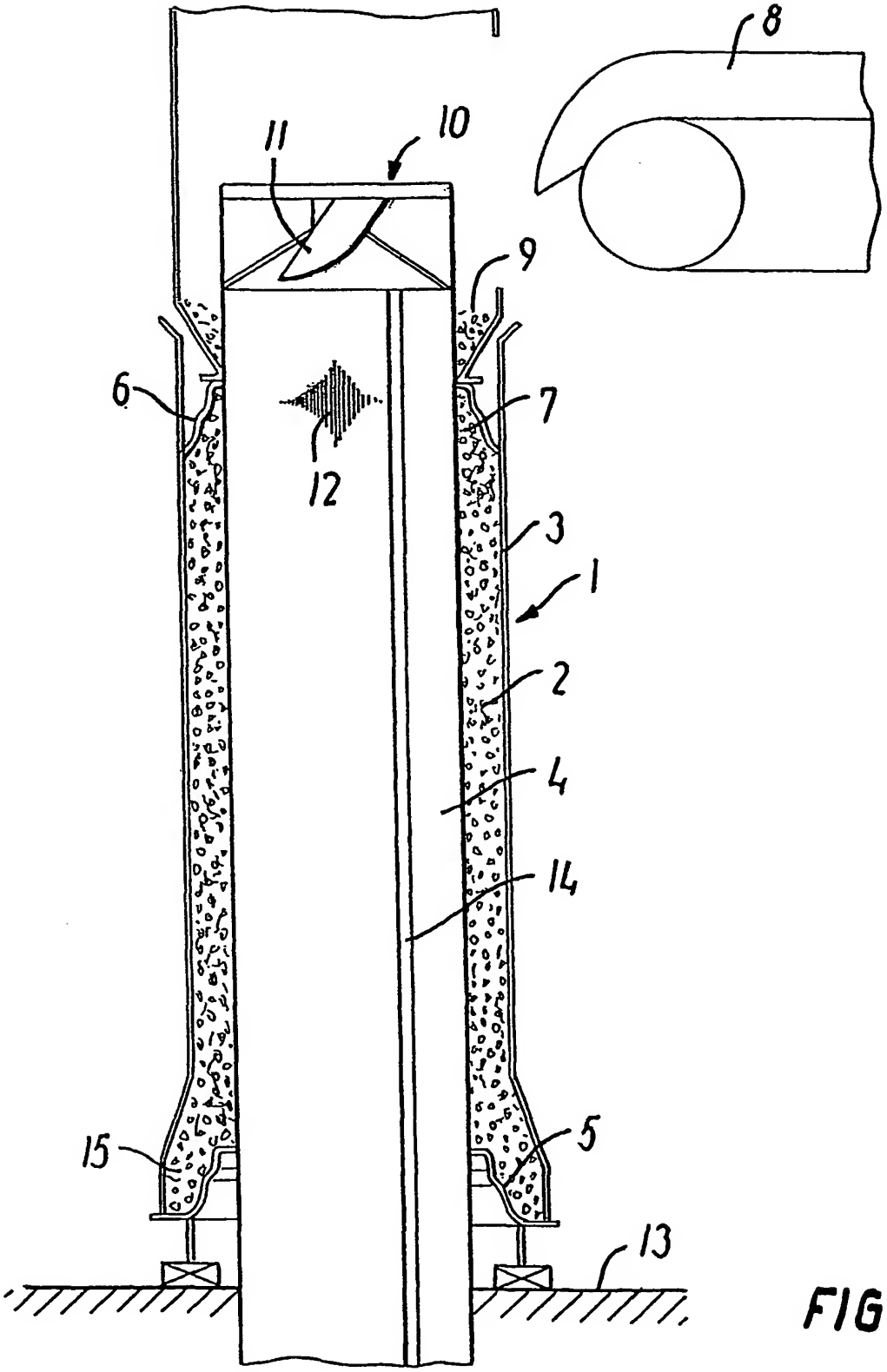

FIG.1

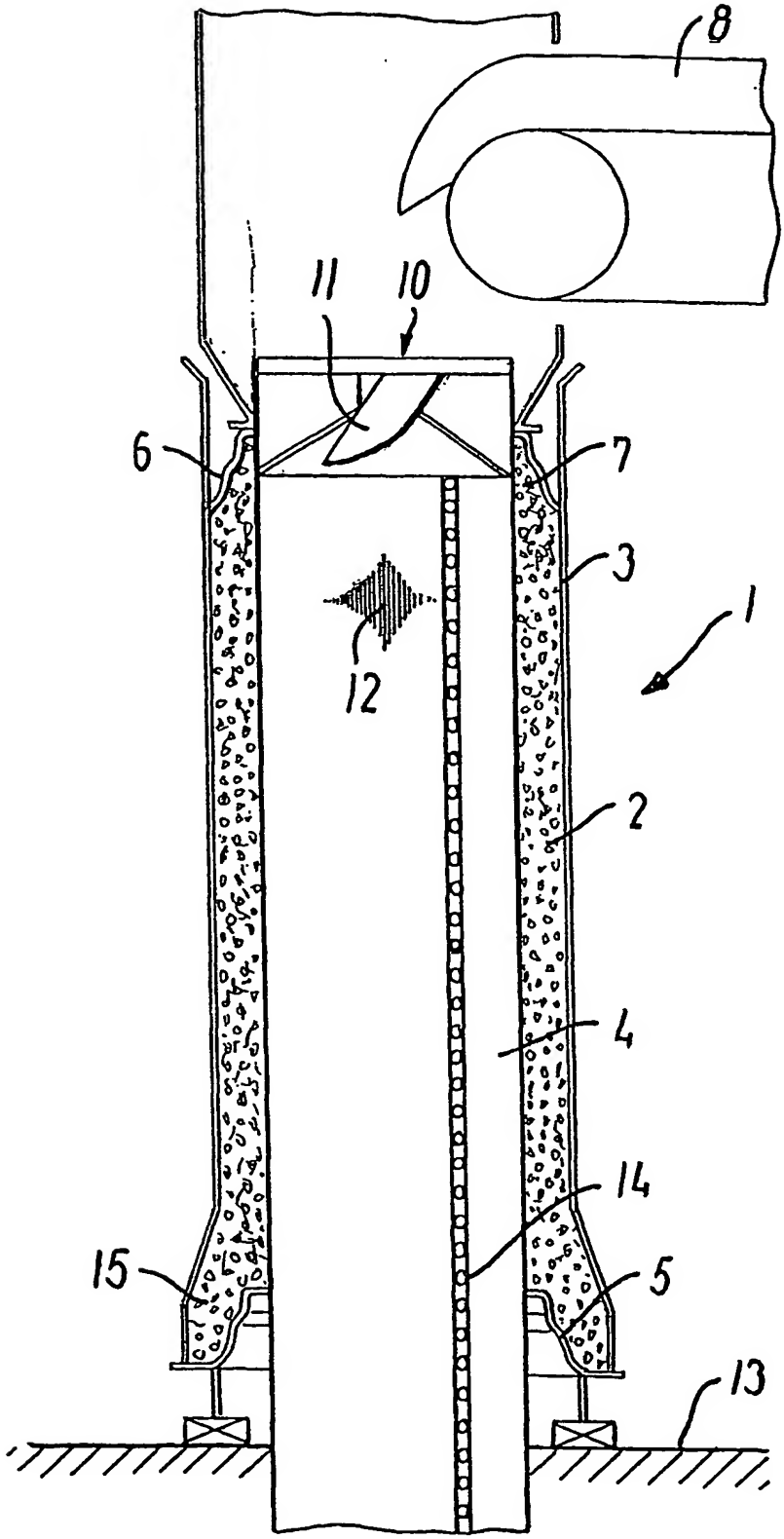

FIG.2

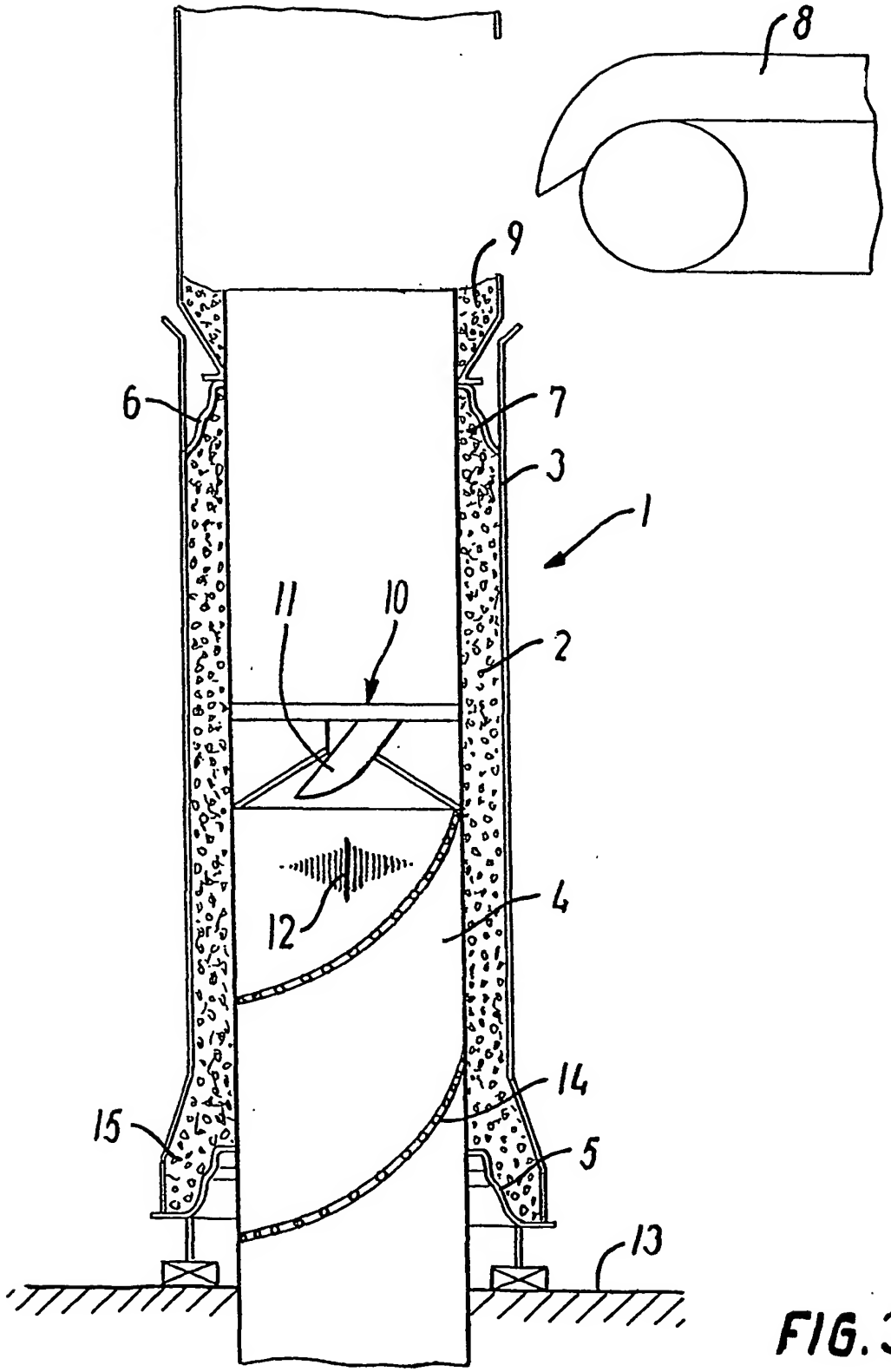

FIG. 3

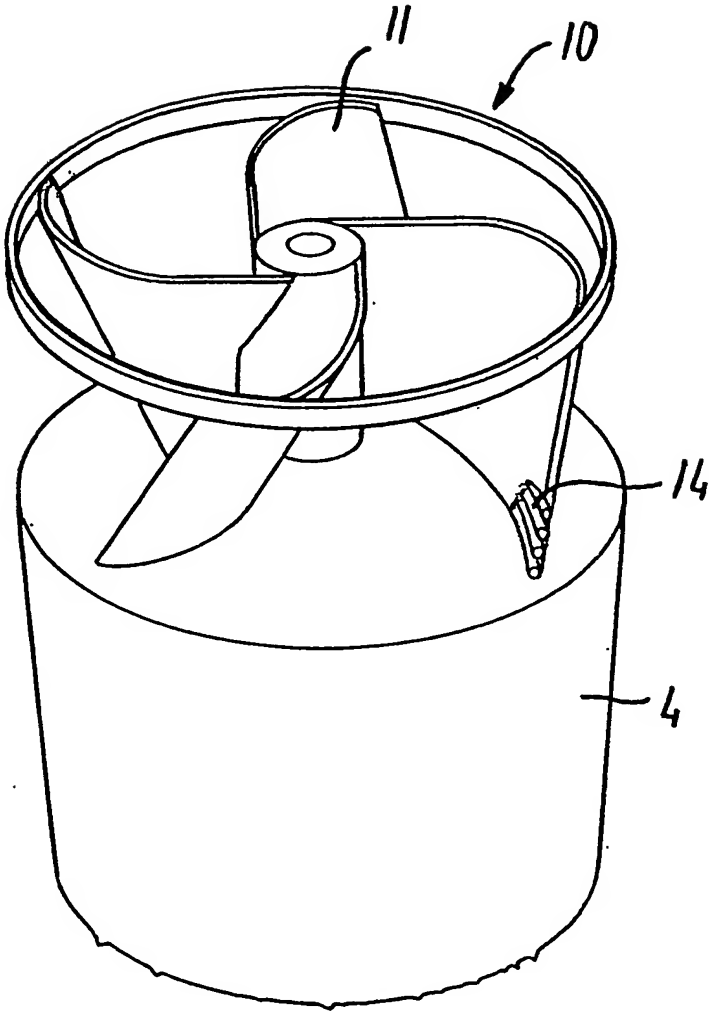

FIG.4

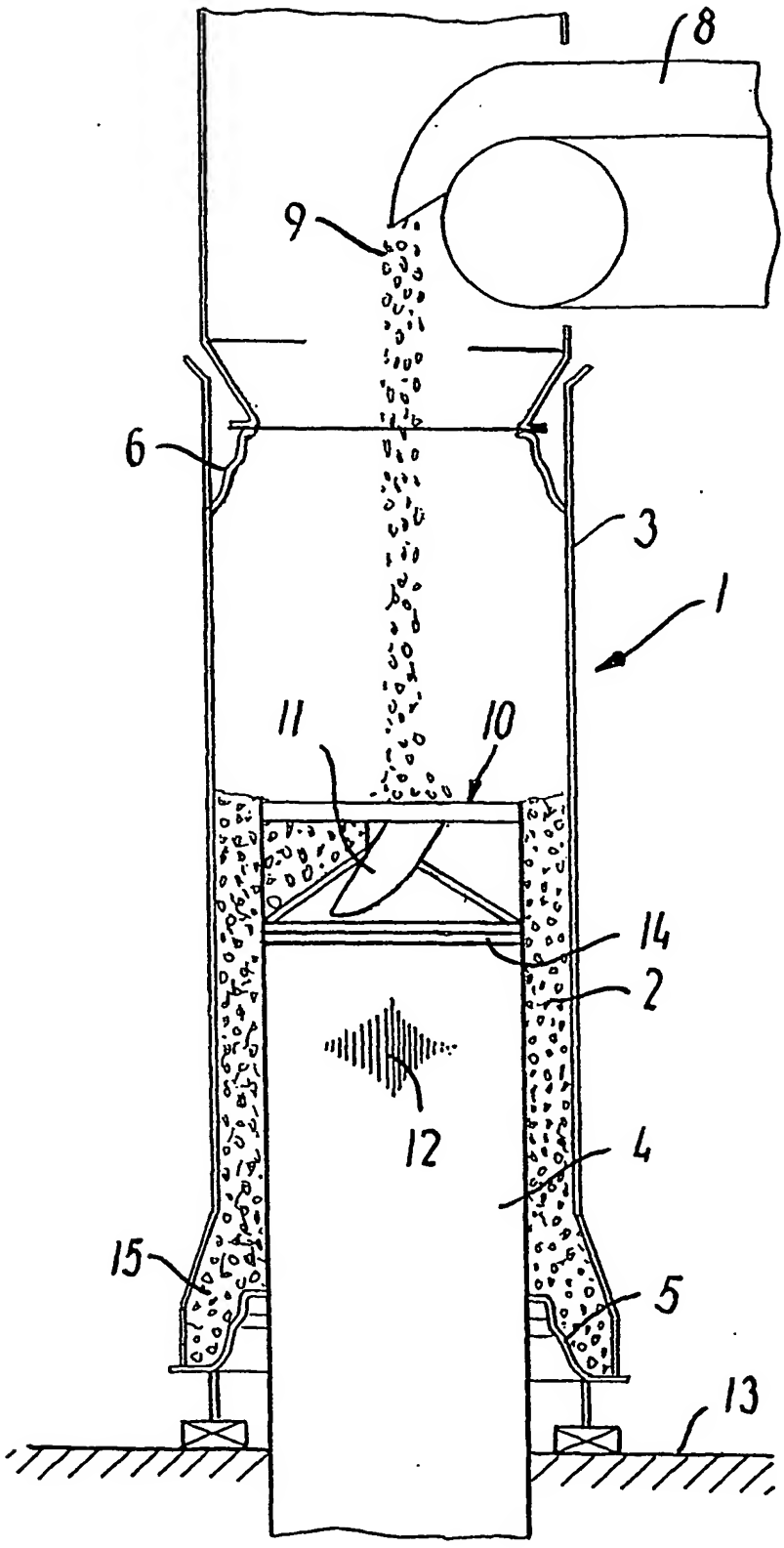

FIG.5

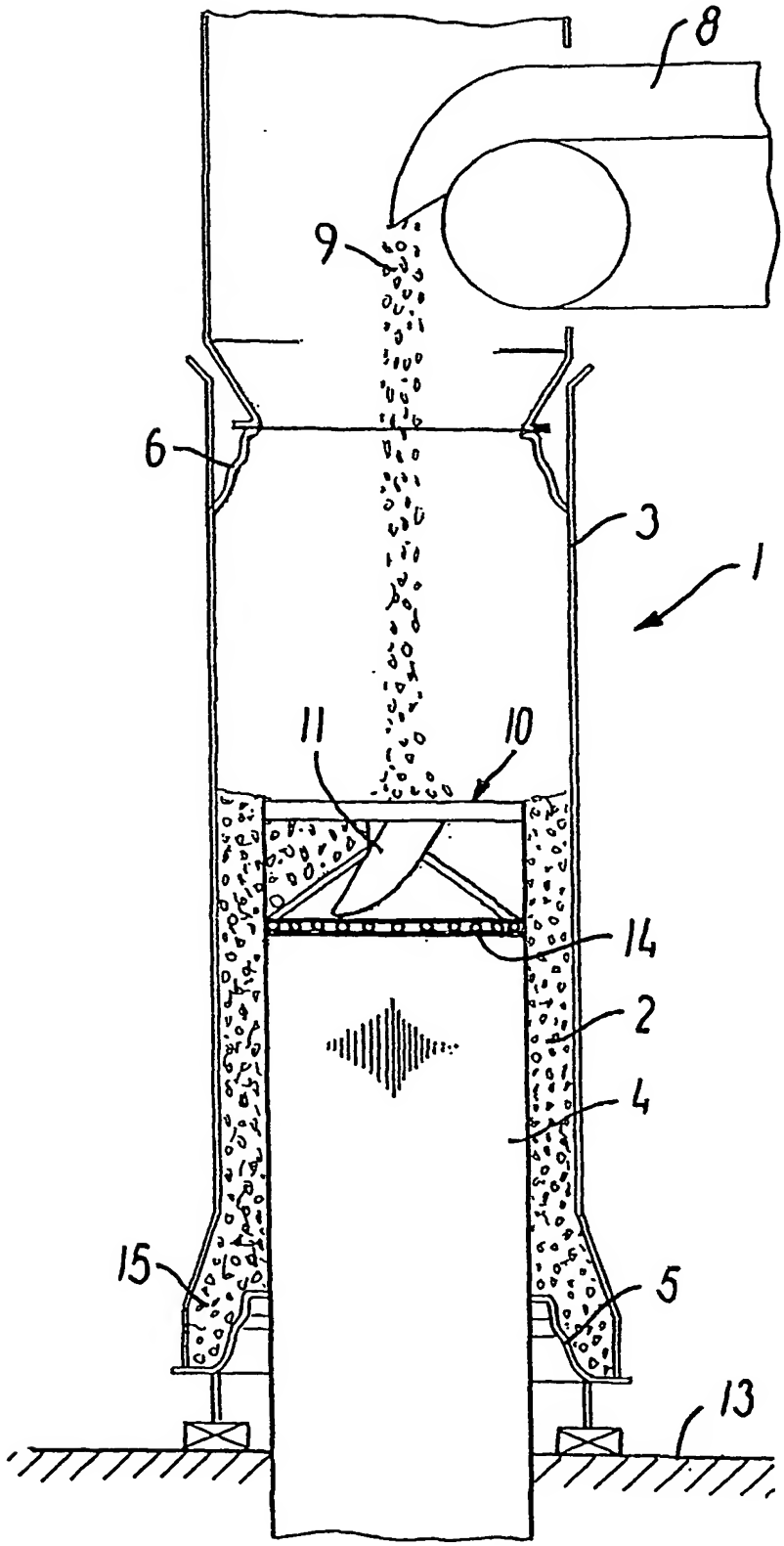

FIG.6

INTERNATIONAL SEARCH REPORT

Application No
PCT 20/04000002

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B28B21/28 B28B21/94

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B28B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 051 223 A (KERN GREGOR) 24 September 1991 (1991-09-24) cited in the application	9,10
A	column 2, line 1 - line 34; figure	1,2,8,11
X	US 2 220 975 A (AODHGAN O'RAHILLY) 12 November 1940 (1940-11-12) the whole document	14,15
X	DATABASE WPI Section PQ, Week 198028 Derwent Publications Ltd., London, GB; Class P64, AN 1980-G0474C XP002281240 -& SU 688 342 A (REINFORCED CONC MAC), 30 September 1979 (1979-09-30) abstract	14

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 May 2004	07/06/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Orij, J

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/[redacted]20/0400000

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 16 46 760 A (MEYER WILHELM DR) 2 September 1971 (1971-09-02) the whole document -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Application No
PCT/DK 20/04000002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 2220975 A	12-11-1940	GB 509113 A	11-07-1939
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